TARDEC Ground Vehicle Robotics

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Provide Transition-Ready, Cost-Effective, and Innovative Robotics and Control System Solutions for Manned, Optionally-Manned, and Unmanned Ground Vehicles, driven by War Fighter Requirements, through Advanced Technology Research, Development, Experimentation, and System Integration

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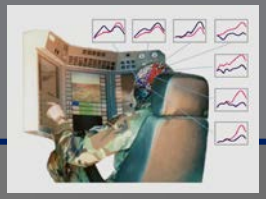
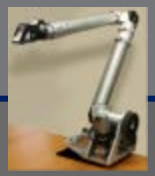
Ground Vehicle Robotics (GVR) Mission

Provide Transition-Ready, Cost-Effective, and Innovative Robotics and Control System Solutions for Manned, Optionally-Manned, and Unmanned Ground Vehicles, driven by War Fighter Requirements, through Advanced Technology Research, Development, Experimentation, and System Integration

The Birthplace of Army Ground Robotics

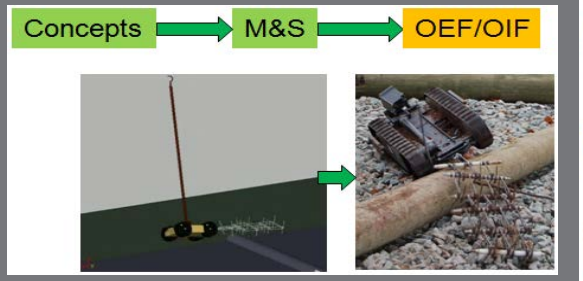
TARDEC Robotics

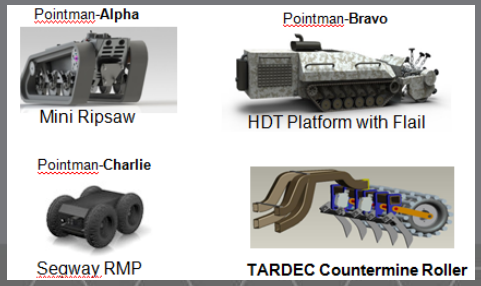


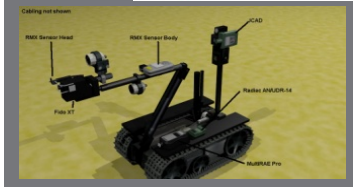


Requirements | Concepts | Analysis | Component Development | Component Testing | System Integration | Virtual Proving Ground | Vehicle Testing/Demo

Supporting the Current Force





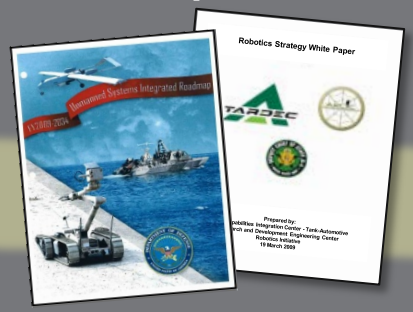


Enabling the Future Fight

GVR Activities

Outreach & Universities

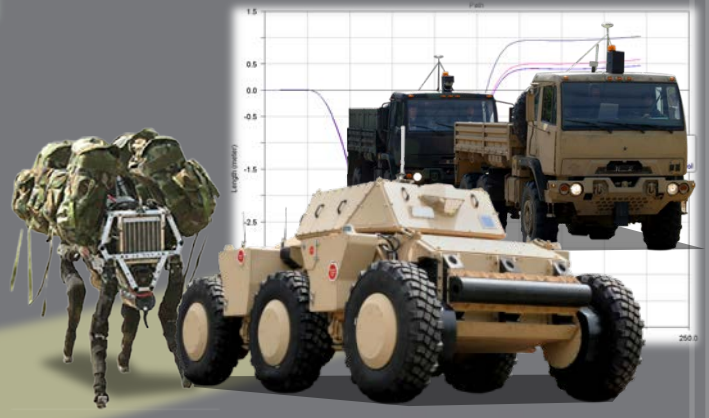
Shaping Requirements



Automotive OEMs and Suppliers

International

System Analysis & Prototypes



Building M&S Capability

Component Development

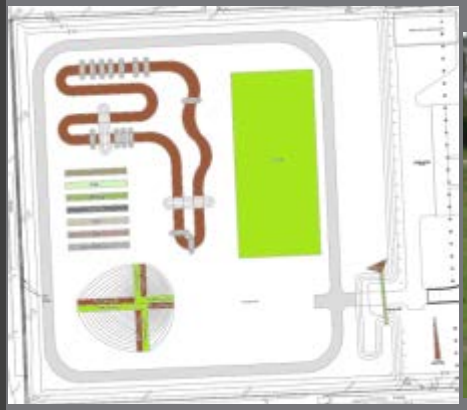
GVR Facilities

Robust – Unique

Laboratory Capabilities

- Robotics VSIL / Modeling and Simulation
  - Autonomous Behaviors
  - Safety System Virtual Test
  - Perception Algorithms
  - Localization Algorithms
  - Active Safety Algorithms
  - HMI Algorithms
  - Hardware/Software in-Loop
- GVR Robotic Development Laboratories
  - 360 Situational Awareness Lab
  - Crewstation Laboratory
  - Robotics Applique Development
  - Small Robot Integration
  - Large Robotic Platform Integration
- Robotics Development Environment
  - Obstacle Course
  - - Culvert, Rubble Pile, Switchbacks
  - - Gap Crossing Pit (Water optional)
  - - Multiple terrain strips
  - - 15%, 20%, 25%, & 30% Grade Hill
- Future Test Facilities at Grayling

Robotic Autonomous Test Track



Robotics Laboratories and Prototype Integration

Small Robotic Development and Integration Laboratory

Large Robotics Development and Integration Laboratory

Sensor/Display/HRI Development

Software and Algorithm Development

Enabling Capabilities

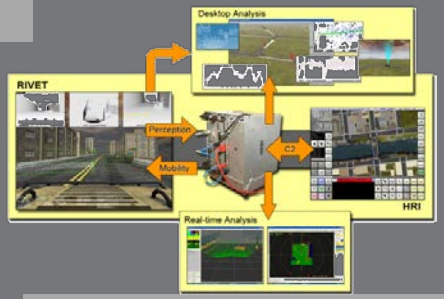
Pedestrian/Vehicle Detection, Classification, & Tracking

Dynamics of Distributed Role Allocation in Teams

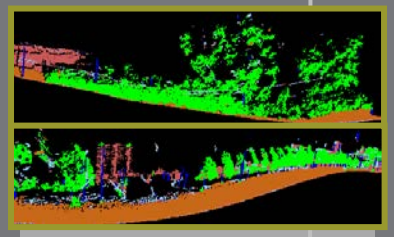
Autonomous Moving Object/Complex Terrain

Collaborating Socially, Organizationally & Culturally

Autonomous Complex Dexterous Manipulation



Modeling & Simulation



Terrain Classification Technologies

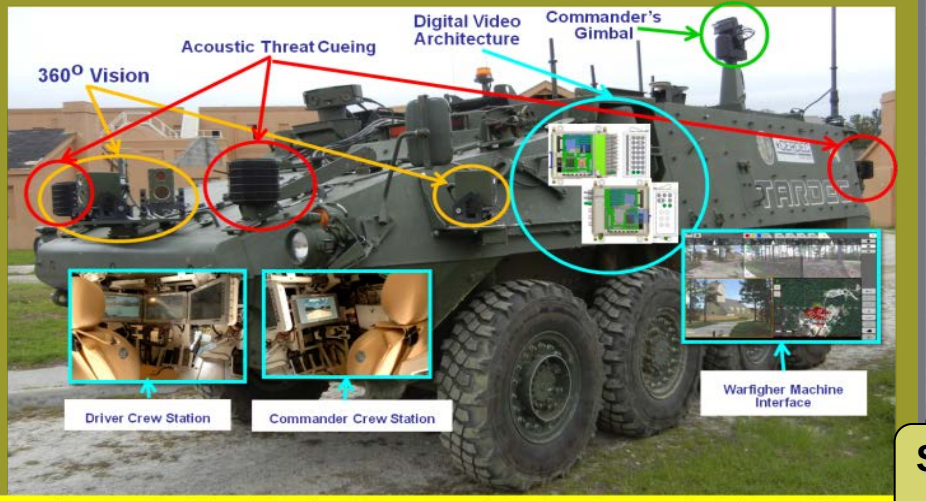
Faster movement and terrain feature mapping through real-time adaptive learning

Plan *Real-time Data* *Dynamic Replan*

Interactively Understanding Situations, Contexts, and Activities

Enabling Technology Programs

Increased Mobility and Operational Performance through Autonomous Technologies (IMOPAT)



Provide visual local situational awareness (LSA) thru electro-optic indirect vision (EOIV) technologies during manned and unmanned platform operations

Safe Ops of Unmanned Systems for Reconnaissance in Complex Environments (SOURCE)

Autonomous Mobility Appliqué System (AMAS) - JCTD

Safe Operations & Autonomous Platform Demonstrator (APD)

Safe Ops

'Rules of the Road', structured environments

APD

Off-road mobility, unstructured environments

Robotic Convoy Operations

Convoy Active Safety Technologies (CAST)

Driverless technology for military trucks

The Robot is a Member of the Unit

- Understand the mission
  - Receive and correctly interpret orders
  - React to changing situations
- Understand the environment
  - Recognize “rubble pile by lamppost”
  - Observe person fleeing checkpoint
  - Spot suspicious activity near intersection
- Move in a tactically correct way
  - Move downrange to IED – and return
  - Check intersection before manned units pass through it
  - Maintain tactical integrity moving through urban environment
- Communicate clearly & efficiently
  - Ask for assistance when needed
  - Report salient activity – e.g., insurgent entering building, fleeing checkpoint
- Perform missions
  - Monitor activity at checkpoint
  - Navigate autonomously to combat outpost
  - Inspect and neutralize IED
  - Perform ISR in urban setting

Able to function in a world designed for humans, to grasp small objects, to open doors, to carry the wounded, etc.

Optionally Manned Vehicles

X-by-wire kit

Autonomy kit

Electronic Architecture

Driving functions only

2 modalities

Human in vehicle

(i.e. shared driving)

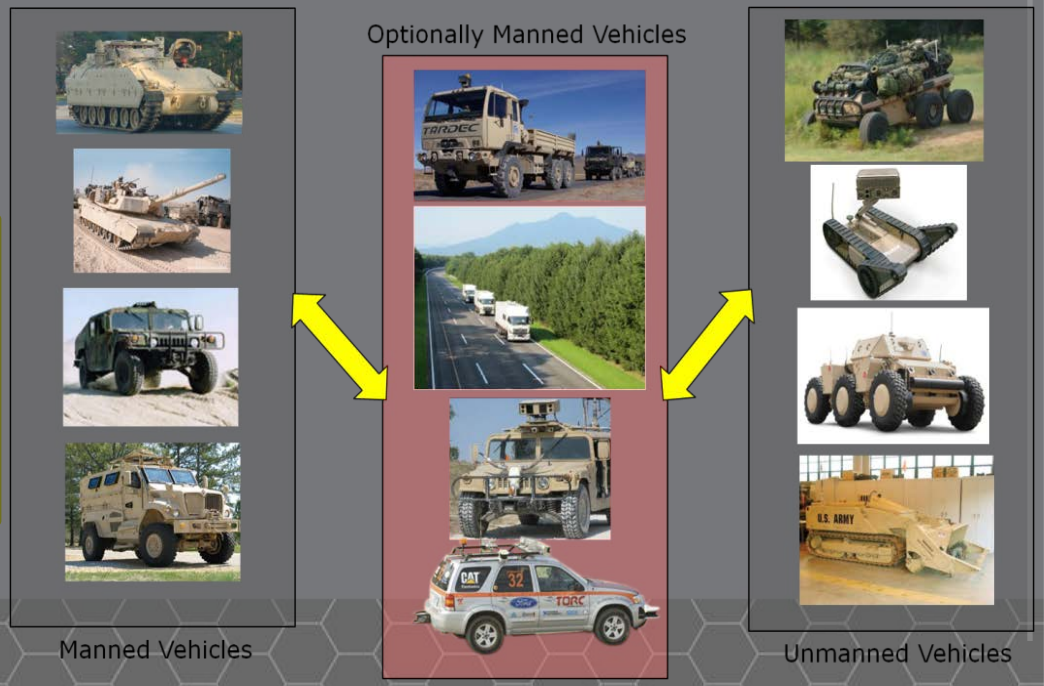
Human NOT in vehicle

(i.e. remotely operated)

invariant across all missions for OMV

Mission Payloads

OMV can be driven by a soldier;
OMV can drive a soldier;
OMV can be remotely operated;
OMV can be autonomous



Ground Robotics Opportunities

- Robotics benefits…
  - Robots can extend the reach of the soldier
  - Robots can reduce the load of the soldier
  - Robots can go into some dangerous places
  - Robots are better at doing some tasks
- Moving beyond current **'fielded'** mobile ground robotics…
  - Mission effective capabilities beyond remotely controlled or tele-operated
  - Ease of control; language/hand signals instead of laptops and game controllers
  - Robots that maintain operational tempo in almost all environments
  - Robots that are inexpensive and have reliability levels approaching automotive standards
  - Intelligent robots that communicate their intention to testers and users
  - **Showing soldiers that robots and unmanned systems are safe, reliable, and can ease their burden and can save their lives!**